

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of optimizing a cycle time of a liquid dispensing module, comprising:

providing a liquid dispensing module ~~having~~ including a dispenser body capable of receiving and discharging a flow of the liquid and a pneumatic actuator, the dispenser body including a flow-control mechanism having a first condition in which the flow of the liquid is discharged from the dispenser body and a second condition in which the flow of the liquid is blocked, the pneumatic actuator ~~having~~ including an air piston housing containing an air cavity, an air piston located in the air cavity, and a solenoid valve capable of controlling the flow of pressurized air to and from the air cavity for alternatively applying an actuation force to the air piston and removing the actuation force from the air piston, the air piston operatively coupled with the flow-control mechanism for providing the first condition when the actuation force is applied and the second condition when the actuation force is removed, the air cavity ~~having~~ characterized by an initial air volume and the pneumatic actuator ~~having~~ characterized by an effective valve flow coefficient;

specifying a first value for one of the initial air volume and the effective valve flow coefficient; and

determining a second value of the other of the initial air volume and the effective valve flow such that the cycle time is less than or equal to 9 milliseconds.

2. (Original) The method of claim 1 wherein the cycle time is less than or equal to 5 milliseconds.

3. (Original) The method of claim 1 wherein the first value is specified for the effective valve flow coefficient and the second value is determined for the initial air volume.

4. (Original) The method of claim 3 wherein the first value is a number ranging between about 0.1 to about 1.4.

5. (Original) The method of claim 4 wherein the cycle time is less than or equal to 5 milliseconds.

6. (Currently Amended) The method of claim 1 further comprising ~~the steps of:~~
heating the liquid received by the dispenser body with a heater; and
thermally insulating the housing of the pneumatic actuator from the heater
for reducing the transfer of heat from the heater to the housing so that the solenoid valve is mountable in abutting, thermally-conductive contact with the air piston housing.

7. (Original) The method of claim 1 wherein the first value is specified for the initial air volume and the second value is determined for the effective valve flow coefficient.

8. (Original) The method of claim 7 wherein the initial air volume is less than about 2170 mm³.

9. (Original) The method of claim 8 wherein the initial air volume is less than about 1500 mm³.

10. (Currently Amended) A liquid dispensing module for dispensing a liquid onto a substrate, comprising:

a dispenser body ~~having~~ including a discharge outlet, said dispenser body capable of receiving a flow of the liquid and discharging the flow of the liquid from said discharge outlet, said dispenser body including a flow-control mechanism ~~having~~ characterized by an open position in which the flow of the liquid is discharged from the ~~dispenser body discharge outlet~~ and a closed position in which the flow of the liquid is blocked;

an actuator operatively coupled with said flow-control mechanism, said actuator capable of actuating said flow-control mechanism between the open and the closed positions to selectively dispense the liquid from said ~~dispenser body~~ discharge outlet; and

a nozzle removably mounted to the dispenser body in fluid communication with said discharge outlet.

11. (Original) The liquid dispenser module of claim 10 wherein said nozzle includes a frustoconical portion and said dispenser body includes a frustoconical recess capable of receiving said frustoconical portion.

12. (Original) The liquid dispenser module of claim 10 wherein said dispenser body further includes a threaded passageway and a set screw threadingly received within said threaded passageway, said set screw having a conical tip, and said nozzle includes a conical recess capable of receiving said conical tip of said set screw so as to apply a holding force between the frustoconical portion and the frustoconical recess.

13. (Currently Amended) A liquid dispensing module for dispensing a liquid onto a substrate, comprising:

a dispenser body ~~having~~ including a liquid inlet, a discharge outlet, a liquid recirculation outlet, and a flow channel capable of directing a flow of the liquid from said liquid inlet to one of said outlet and said recirculation outlet;

a first valve seat disposed in said flow channel between said recirculation outlet and said liquid inlet;

a second valve seat disposed in said flow channel between said discharge outlet and said liquid inlet;

a first valve stem segment ~~having~~ including a first valve plug located between said first valve seat and said recirculation outlet;

a second valve stem segment ~~having~~ including a second valve plug located between said second valve seat and said discharge outlet, said second valve

stem segment operatively coupled for movement with said first valve stem segment, said first and said second valve stem segments being movable between a first position in which said first valve plug contacts said first valve seat to stop the flow of the liquid from said liquid inlet to said recirculation outlet and said second valve plug is out of contact with said valve seat to permit the flow of the liquid from said liquid inlet to said discharge outlet and a second position in which said first valve plug is out of contact with said first valve seat to permit the flow of the liquid from said liquid inlet to said recirculation outlet and said first valve plug contacts said first valve seat to ~~stop~~ halt the flow of the liquid from said liquid inlet to said discharge outlet; and

an actuator associated with said dispenser body, said actuator operatively coupled with one of said first and said second valve stem segments to selectively apply an actuation force for moving said first and said second valve stem segments to provide said first and said second positions for selectively dispensing the flow of the liquid from said discharge outlet.

14. (Original) The liquid dispenser module of claim 13 wherein said actuator is operatively coupled with said first valve stem segment.

15. (Currently Amended) The liquid dispenser module of claim 13 wherein said first valve plug is a spherical head and said first valve seat ~~has~~ includes an annular sealing surface capable of making a sealing engagement with said spherical head.

16. (Original) The liquid dispenser module of claim 13 wherein said second valve plug includes a first frustoconical sealing surface and said second valve seat includes a second frustoconical sealing surface capable of making a sealing engagement with said first frustoconical sealing surface.

17. (Original) The liquid dispenser module of claim 13 further comprising:
a first biasing element for applying a first biasing force to said first valve stem segment that urges said first valve plug in a direction toward said first valve seat.

18. (Original) The liquid dispenser module of claim 17 further comprising:
a second biasing element for applying a second biasing force to said second valve stem segment that urges said second valve plug in a direction toward said second valve seat.

19. (Original) The liquid dispenser module of claim 18 wherein said second biasing force is greater than said first biasing force so that said first and said second valve stem segments are in said second position when said actuation force is not applied.

20. (Original) The liquid dispenser module of claim 18 wherein the sum of said first biasing force and said actuation force is larger than said second biasing force so that said first and said second valve stem segments are in said second position when said actuation force is applied.

21. (New) A dispensing apparatus for dispensing a liquid, comprising:

a liquid distribution manifold capable of heating the liquid;

a dispenser body capable of receiving a flow of the liquid from said liquid distribution manifold, said dispenser body including a flow-control mechanism having a first condition in which the flow of the liquid is discharged from said dispenser body and a second condition in which the flow of the liquid is blocked;

a pneumatic actuator including a solenoid valve, an air piston housing thermally coupled with said solenoid valve, an air cavity defined within said air piston housing, and an air piston positioned within said air cavity, said air piston being coupled with said flow-control mechanism for providing said first and second conditions in response to a flow of pressurized fluid to said air cavity from said solenoid valve; and

a thermally insulating shield positioned between said air piston housing and said liquid distribution manifold, said shield capable of reducing the transfer of heat from said liquid distribution manifold to said air piston housing.

22. (New) The dispensing apparatus of claim 21, wherein said air piston housing is formed of a first material characterized by a first thermal conductivity and said thermally insulating shield is formed of a second material characterized by a second thermal conductivity that is less than the first thermal conductivity.

23. (New) The dispensing apparatus of claim 22, wherein said second material forming said thermally insulating shield is a nonmetal.

24. (New) The dispensing apparatus of claim 23, wherein said nonmetal is a material selected from the group consisting of ceramics, polymers and glass fibers.

25. (New) The dispensing apparatus of claim 21, wherein said thermally insulating shield is an imperforate member.

26. (New) The dispensing apparatus of claim 21, wherein said throughbore includes a perimeter enclosed between said air piston housing and said liquid distribution manifold such that the gas confined therein is substantially stagnant.

27. (New) The dispensing apparatus of claim 21, wherein said thermally insulating shield includes a flat panel contacting said air piston housing and a plurality of projections extending between the said panel and said liquid distribution manifold, said flat panel characterized by a first cross-sectional area and each of said projections characterized by a second cross-sectional area that is smaller than said first cross-sectional area for reducing the conduction of heat from said liquid distribution manifold to said flat panel.

28. (New) The dispensing apparatus of claim 21, wherein said thermally insulating shield includes a spacer having a thin sidewall defining an enclosed space filled with a gas, said sidewall extending between said air piston housing and said liquid distribution manifold.

29. (New) The dispensing apparatus of claim 28, wherein said thermally insulating shield includes one or more dividing walls that compartmentalize said enclosed space.

30. (New) The dispensing apparatus of claim 28, wherein said sidewall includes a perimeter enclosed between said air piston housing and said heated support structure so that the gas in said enclosed space is substantially stagnant.